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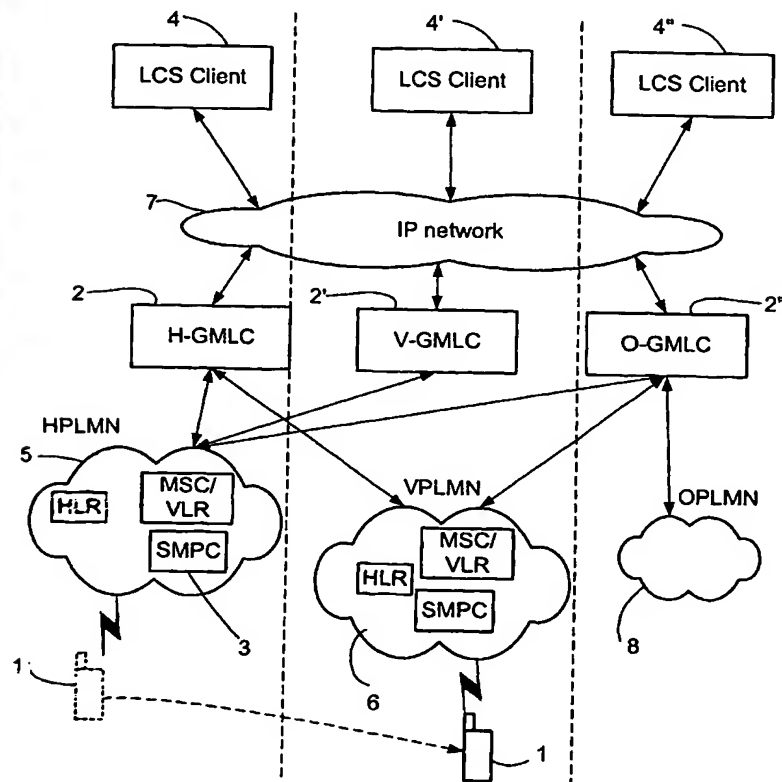
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(54) Title: A METHOD AND SYSTEM FOR POSITIONING IN A MOBILE COMMUNICATIONS NETWORK



(57) Abstract: A method and system for obtaining the position of a mobile station (1) located in a current network of a communications system including a plurality of networks supporting different positioning protocols. The current network (6) (107) is identified at a location centre (2) based on the identified current network (6), a suitable positioning protocol is selected among at least two protocols for communication of location information with the current network (6) (108).



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A METHOD AND SYSTEM FOR POSITIONING IN A MOBILE
COMMUNICATIONS NETWORK

Technical field of the invention

5 The present invention relates to a method and system
for obtaining the position of a mobile station in a
communications system, and more particularly to a method
and system for a location service to obtain the position
of a mobile station when located in a current network,
10 wherein a home network, an originating network or said
current network may use different mechanisms/protocols for
positioning signalling between said networks.

Background of the invention

15 Positioning is the process of geographically
locating Mobile Stations (MS) in a Public Land Mobile
Network (PLMN) by collecting and analyzing needed
information, and after calculating the position, reporting
it to an application for further usage.

20 Location-based services are forecasted to be an
important feature in mobile communications network. A
system for mobile positioning enables an operator to
provide location-based services to its customers. Location
information is an important enabler for many of the new
25 services in the third generation mobile networks. Also, in
some countries there are legal requirements on providing
location information when an emergency call is made from
an MS.

30 An ETSI standardised Gateway Mobile Location Centre
(GMLC) discloses an example of a vital part of a mobile
positioning system. The GMLC is the link between the PLMN
and location services clients (LCS-C). It receives the
positioning requests, performs the necessary authentica-
tion, initiates the positioning in the PLMN, and sends
35 back the positioning information to the requesting
application.

 The knowledge of the location of a mobile entity
opens up a new set of applications and enhance existing

ones. A number of different applications in different fields, such as governmental, operators or commercial applications are and will be provided.

Each target group has its own demands and needs
5 concerning location based services. Governmental use would typically be applicable for public welfare such as emergency calls and infrastructure planning. Operators have the ability for more accurate network planning by applying location information of large groups of mobile
10 users. Commercial applications open up a whole new set of services.

Depending on the type of application it can be run either by an operator or a service provider. The operator is able to offer service providers access to location
15 information, and the operator can also run its own applications. Existing services can be greatly enhanced and new services can be developed, with the knowledge of the geographical position of a mobile entity. The GMLC and a Serving Mobile Location Centre (SMLC) - which collects
20 position information from the communications network and calculates the co-ordinates to be used by the application allows authorized applications, provided by the operator or third parties, to locate an MS using a variety of methods.

25 One important aspect of positioning is the support for location services (LCS) when mobile subscribers are roaming, i.e when a mobile subscriber is able to travel freely between cells while engaged in a single phone call, and international roaming, which means that the user can
30 use the option of taking its phone abroad and using it in a Visited Public Land Mobile Network (VPLMN).

Another important aspect is that some applications, for example "friend-finder"-like applications, may need to obtain the position of MSs which are subscribers of other
35 PLMNs.

Different PLMNs may support different location and roaming location mechanisms/protocols.

One such roaming location mechanism/protocol, known in the art, is used when the target MS is not located in its home PLMN (HPLMN) and SS7 signalling is used between the HPLMN and a VPLMN. In this mechanism the GMLC of the
5 requesting LCS-C first interrogates the HLR (Home Location Register) in the home PLMN of the target MS for positioning routing information, i.e the current MSC/VLR (Mobile Switching Centre/Visitor Location Register) address of the MS. Then, this MSC/VLR is interrogated for positioning
10 information. The MSC/VLR address can be located in any PLMN provided that it supports the same SS7 positioning roaming mechanism and that an SS7 roaming agreement exists.

Another approach for a roaming location mechanism/
15 protocol is to use the Internet Protocol (IP). In this mechanism the GMLC of the LCS-C first interrogates the GMLC in the home PLMN of the target MS for positioning routing information, i.e in the PLMN where the MS is currently located. Then, the GMLC of this current PLMN is
20 interrogated for positioning information. The MS can be located in any PLMN provided that it supports the same IP positioning roaming mechanism.

In addition to the above described methods, there also exist proprietary roaming support mechanisms and new
25 proprietary solutions can be anticipated to evolve over time due to the consolidation of the number of PLMN operators.

Thus, there will probably exist various mechanisms/protocols and different operators and vendors
30 will support these in various degrees. Further, when a positioning request is initiated it is not known which mechanisms will be needed during the course of the location procedure, since this will depend on in which PLMN the target MS is currently located, and the
35 capabilities of that PLMN.

These state of the art solutions require that all PLMNs involved when positioning an MS must be able to support the same positioning roaming mechanism/protocol.

As set out above, it is anticipated that this will not be the case. Therefore, it is apparent that interoperability will be seriously jeopardized.

Also, it is anticipated that initiated but not
5 successful positioning requests will create excess traffic load and thereby jeopardize system performance.

Summary of the present invention

It is an object of the present invention to mitigate
10 the above described drawbacks of the prior art by providing a method for a location service requested from an originating network to obtain the position of a mobile station when located in a current network, wherein said originating network and current network uses different
15 positioning mechanisms/protocols.

In order to achieve said object the invention provides a method for obtaining the position of a mobile station in a communications system, wherein the current network of the mobile station is identified, and a
20 suitable positioning protocol is selected, based on the identified current network.

The invention also provides a system comprising means for working the method, which is characterised by a protocol controller configured to apply positioning
25 protocols for different communication networks for usage in communication with the networks, a processing component configured to identify the mobile station's current network, and based on the identified current network, select among said positioning protocols a suitable
30 positioning protocol for communication with the current network.

Brief description of the drawings

The following detailed description, given by way of
35 example and not intended to limit the present invention solely thereto, will best be appreciated in conjunction with the accompanying drawings, wherein like reference numerals denote like elements and parts, in which:

FIG 1 illustrates a system according to the invention providing location service for positioning a mobile station, wherein an originating network and a current network uses different positioning mechanisms/protocols, and

FIG 2 is a flow chart illustrating the method of positioning a mobile station according to the invention.

Detailed description of the invention

With reference now to the figures wherein like or similar elements are designated with identical reference numerals, there is a block diagram and a flowchart depicting the invention. The purpose of this diagram is to illustrate the features of the invention and the basic principles of operation of embodiments thereof. This diagram is not necessarily intended to schematically represent particular modules of circuitry or any particular data or control paths. It should also be emphasised that the terms "comprises" and "comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

Figure 1 illustrates one embodiment of a communication network configuration including a first embodiment of the system according to the invention for providing location services for positioning a subscriber with a portable radio communication apparatus or equipment such as a mobile telephone 1 when located in a current network 6, wherein a home network 5 and the current network 6 uses different positioning mechanisms/protocols.

The term portable radio communication equipment, which herein after is referred to as a mobile radio terminal or mobile phone includes but is not limited to all equipment such as mobile telephones, pagers, communicators, electronic organizers, smart phones or the like.

The system configuration comprises a home Gateway Mobile Location Centre (H-GMLC) 2 and a Serving Mobile Location Centre (SMLC) 3. The GMLC is a vital part of a mobile positioning system. The GMLC is the Ericsson Gateway Mobile Positioning Centre (GMPC), which is Ericsson's implementation of, but is not limited to, the by ETSI standardised Gateway Mobile Location Centre (GMLC). In one embodiment of the invention, the GMLC 2 is a system that comprises at least a computer processor or other processing component and a data store operatively connected to the processing component.

The GMLC 2 is the GSM/UMTS PLMN node to be accessed by an external location services (LCS) client 4 when it requests the location of a certain mobile station. The GMLC 2 offers interfaces, XML/HTTP based in this embodiment, through which the LCS client 4, 4', 4" and the GMLC 2, 2', 2" can communicate, for example over an IP network 7, e.g. the Internet. The communication includes positioning requests from the LCS 4, 4', 4" client and positioning answers from the GMLC 2, 2', 2". Each GMLC 2, 2', 2" is adapted to handle connections from multiple LCS clients 4, and/or 4', and/or 4" simultaneously. Moreover, the GMLC 2 performs, among other things, an authorization check on the request.

The authorized request is delivered to the SMLC 3 via a PLMN 5, for example a GSM network. The SMLC 3 collects position information from the GSM network 5 and calculates the location, such as co-ordinates, to be used by the service or client 4. The location are delivered to the GMLC 2, which is adapted to receive the location and create a location response. This response is replied to the requesting LCS-C 4.

According to the invention, the GMLC 2 is adapted to provide support for LCS where position needs to be obtained for roaming terminals and/or terminals belonging to other PLMNs 6. The GMLC 2 has information to dynamically select a protocol, SS7 or IP-based in this embodiment, to be used in the communication of positioning

data with each specific PLMN 5,6. Thus, based on roaming capability information defined in the GMLC 2 for each HPLMN 5 and VPLMN 6, the GMLC 2 is adapted to select the proper protocol to be used when addressing the particular PLMN 5, 6 with a positioning request or routing request. The GMLC 2 is in this embodiment of the invention configured, but not limited, to select between different roaming protocols, for example SS7 based protocols, or IP based protocols such as the GMLC-centric IP roaming protocol or location middleware (LMw) centric IP roaming protocols. It should therefore be apparent to those skilled in the art that the invention is not limited to be employed in an GMLC but could also be located in for example a location middleware. Also, in one embodiment LMw is used as an interconnect layer between LCS clients and GMLCs. In a such embodiment, network to network communication may be performed between LMw nodes.

One SS7 protocol is defined in the LCS standards Stage 2 GSM TS 03.71, v 8.2.0 and GSM TS 29.002 which are enclosed herein by reference. One IP based roaming protocol is the MLP 3.0.0 developed by Location Interoperability Forum (LIF) which is enclosed herein by reference.

A flow chart in FIG 2 illustrates one embodiment of a method of positioning a subscriber according to the invention. In step 101 the LCS client 4 sends a positioning request to the GMLC 2. The GMLC receives the request in step 102, analyses and identifies the subscriber's home PLMN (HPLMN) 5 in an LCS signalling list in step 103. Said LCS signalling list comprises entries, each including a network identifier and a protocol. Based on the result from the identification and analysis in step 103, a suitable positioning protocol, for example SS7, is selected for communication with the home PLMN in step 104. A routing information request is sent to the home PLMN 5 in step 105 and an answer is received by the GMLC 2 from the PLMN 5 in step 106.

When the GMLC 2 has received the answer it analyses the parameter data and identifies the subscriber's current PLMN in the LCS signalling list in step 107. In this example the MS 1 is roaming in a visited PLMN 6. Based on
5 the result from the identification and analysis in step 107, a suitable positioning protocol, for example an IP based protocol using the IP network 7, is selected for communication with the visited PLMN 6 in step 108. A position request is sent to the visited PLMN 6 in step 109
10 and an answer including co-ordinates and/or other location information about the roaming subscriber and its apparatus 1 is received by the GMLC 2 from the VPLMN 6 in step 110.

Finally, the GMLC 2 creates a position response and replies it to the requesting LCS-C 4 in step 111.

15 The method, system and apparatus according to the invention is however not limited to positioning of roaming MSs, but are capable of positioning MSs in all cases involving positioning related communication between PLMNs. One example of a traffic case where such communication is
20 needed is when an LCS client 4" using an originating GMLC (O-GMLC) 2" and needs to locate an MS which is a subscriber to another PLMN than an OPLMN (Originating PLMN) 8, independently on whether the MS is roaming outside its home PLMN or not. Another such traffic case
25 occurs when an MS 1 is currently located in its home network HPLMN 5 or a visited network VPLMN 6 but accesses a location based service, using another LCS-C (4") associated with an originating GMLC (O-GMLC) (2").

In addition, the invention also extends to computer
30 programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice when executed on a computer. The program may be in the form of source code, object code a code suitable for use in the implementation of the method according to the
35 invention. The carrier can be any entity or device capable of carrying the program. For example the carrier may be a record medium, computer memory, read-only memory or an electrical carrier signal.

Although one embodiment of the method, system and apparatus of the invention has been illustrated in the accompanying drawings and described in the foregoing detailed description, it will be understood that the
5 invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

10

CLAIMS

1. A method for obtaining the position of a mobile station (1) located in a current network of a communications system including a plurality of networks supporting different positioning protocols, **characterised** by the steps of:
- identifying at a location centre (2, 2', 2'') the current network (6) (107) of said mobile station,
- based on said identified current network (6), selecting among at least two protocols a suitable positioning protocol for communication of location information with said current network (6) (108).
- 15 GLÖM INTE SYSTEM KRAV!
2. A method according to claim 1, **characterised** by before the steps of identifying the current network (6) (107) of the mobile station, the further steps of:
- receiving at said location centre a positioning request (102),
- identifying the subscriber's home network (5) (103), based on said identified home network (5), selecting a suitable positioning protocol for communication with said home network (5) (104),
- 25 sending a routing information request to the home network (5) (105),
- receiving an answer from the home network (5) (106), and
- analysing the answer for identifying the current network (6) of the mobile station (107).
- 30
3. A method according to claim 1 or 2, **characterised** by the further steps of:
- sending a position information request to the current network (6) (109), and
- 35 receiving an answer including location information about the subscriber (1) from the current network (6) (110).

4. A method according to any of the preceding claims, **characterised** in that any of the SS7 protocol, MLP or IP roaming protocol is selected.

5

5. A system for obtaining the position of a mobile station (1) located in a current network of a communications system including a plurality of networks supporting different positioning protocols, **characterised** by:

10

a processing component configured to:

identify the current network (6)(107) of the mobile station, and

based on said identified current network (6), select among at least two protocols a suitable positioning protocol for communication of location information with said current network (6)(108).

15

6. A system according to claim 5, **characterised** by a receiving component and a sending component, wherein said receiving component is configured to receive a positioning request (102) from an location services (LCS) client (4,4',4"),

20

said processing component is configured to identify a home network (5)(103) for the subscriber (1); based on said identified home network (5), select a suitable positioning protocol from said positioning protocols for communication with said home network (5)(104),

25

said sending component is configured to send a routing information request to the home network (5)(105), said receiving component is configured to receive an answer from the home network (5)(106), and

30

said processing component is configured to analyse the answer for identifying the current network (6)(107) of the mobile station (1).

35

7. A system according to claim 5 or 6, **characterised** in that said sending component is configured to send a

routing information request to the visited network
(6) (109), and

said receiving component is configured to receive an
answer including location information about the roaming
5 subscriber (1) from the visited network (6) (110).

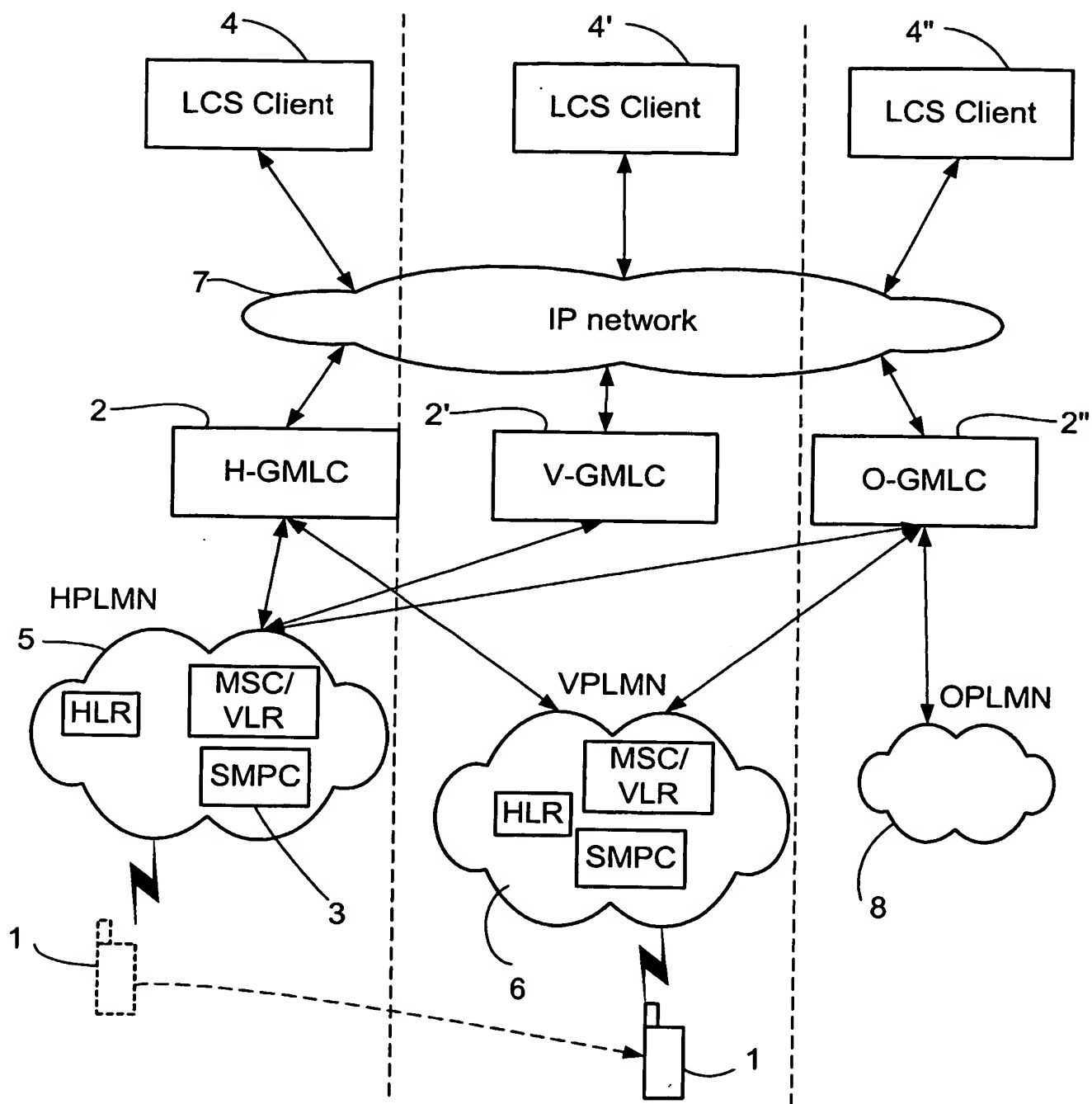
8. A system according to any of the claims 5-7,
characterised in that said positioning protocols are any
of the SS7 protocol, and/or GMLC-centric IP roaming
10 protocol and/or location middleware IP roaming protocol.

9. A computer program comprising program
instructions for causing a computer to perform the method
of any of the claims 1-4.
15

10. A computer program on a carrier and comprising
computer executable instructions for causing a computer to
perform the method according to claims 1-4.

20 11. A computer program according to claim 10,
wherein said carrier is a record medium, computer memory,
read-only memory or an electrical carrier signal.

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**FIG. 1**

2/2

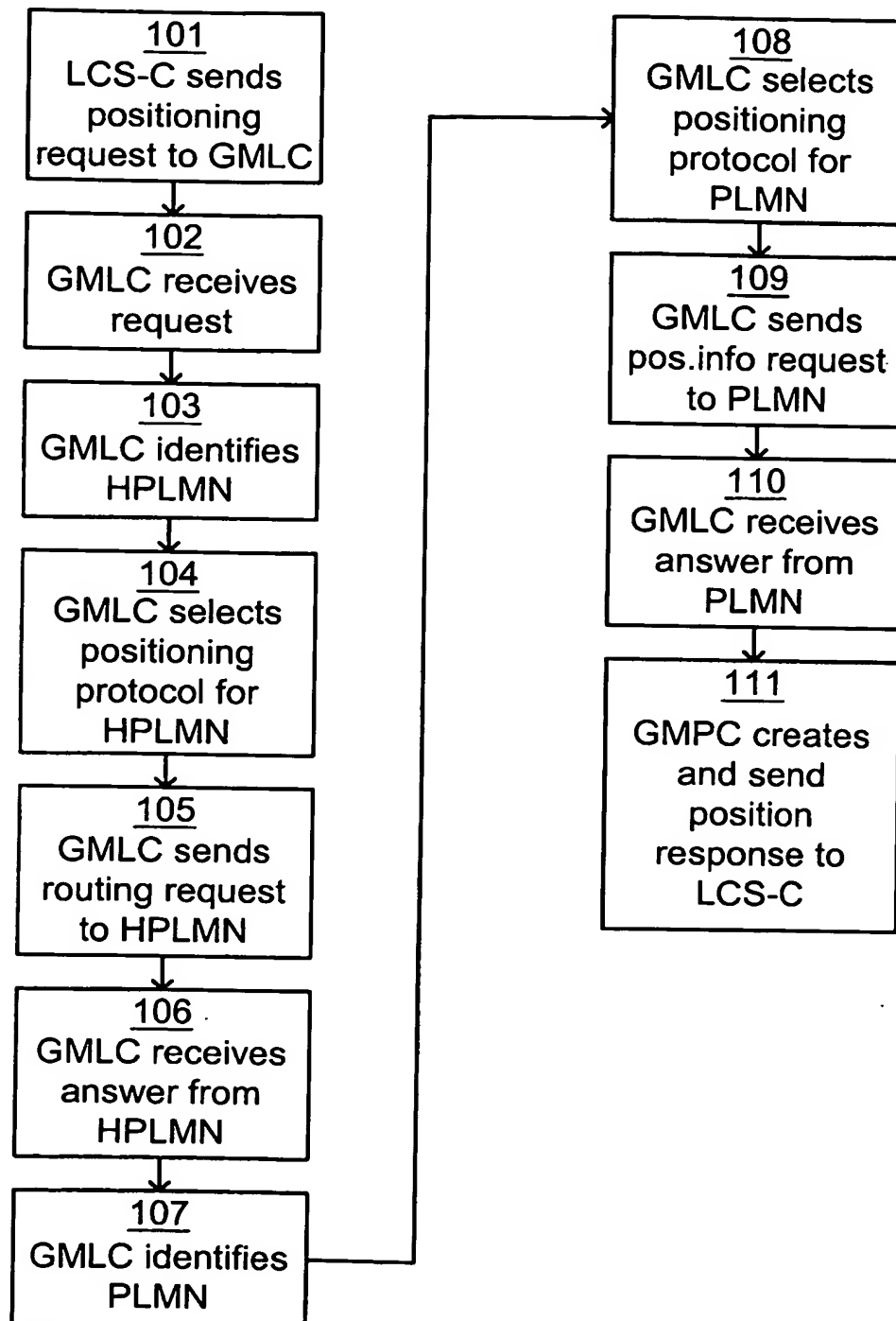


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 02/02308

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2001003093 A1 (MAGNUS LUNDIN), 7 June 2001 (07.06.01), abstract, page 1 paragraph [6] - paragraph[11]; page 2 paragraph [21] - paragraph [29]	1-11
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A	WO 9946948 A1 (ERICSSON INC.), 16 Sept 1999 (16.09.99), page 6, line 13 - page 9, line 6	1-11
	--	
E,X	WO 03039187 A1 (TELEFONAKTIEABOLAGET LM ERICSSON), 8 May 2003 (08.05.03), page 2 - page 6, abstract	1-11
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☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/06/03

International application No.

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Patent document cited in search report			Publication date	Patent family member(s)		Publication date
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